Bepaling van den Debije-Waller factor van eenige metalen bij hoogere temperaturen

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SUMMARY.

The present thesis deals with the influence of the temperature of the reflecting crystal on the intensity of X-ray reflection. Chapter Ia contains a survey of the theories on this problem put forward by DEBIJE, WALLER and ZENER and JAUNCEY. The influence of the temperature is expressed by the factor e^{-2M} in formula (1) (p. 1). M is given by formulae (2) (p. 5) and (3) (p. 6). Chapter I*b* sums up the experiments which have been made until now. Chapter Ic explains the purpose of this investigation, which is a threefold one:

1. a closer investigation of the deviatons from the theory at high temperatures;
2. a comparison with the results obtained from specific heat measurements;
3. a comparison with the results obtained from electrical resistance measurements.

Chapter II describes the method and apparatus used. In carrying out the experiments, the DEBIJE-SCHERRER methode was employed. An examination was made of silver and palladium at temperatures varying from room temperature to 600° C for silver and to 750° C for palladium. Photographic exposures were made at room tempeture and at a higher temperature on the same film. The blackening of the lines was calculated from the curves recorded by a Moll photometer. The intensity was assumed to be proportional to the blackening. Only lines with a reflection angle of more than 90 degrees were used. The temperatures were measured by the shift of the lines on the film caused by the delatation of the crystal. In figures 2 and 3 the quantity A, wich is proportional to M (see formula (4), p. 17), is plotted against the temperature. The characteristic temperature Θ was derived from the straight part of the curve. For silver Θ was found to be 230° K, for palladium 300° K.

Chapter IIIa contains the calculation of the intensity of the reflected lines based on the Einstein-model of a rigid body on admitting terms of the fourth power in the potential energy of the crystal. In the first approximation the same result as in the absence of anharmonic terms was found for M when expressed in $\overline{z^2}$ (i.e. the mean square displacement of an atom from its equilibrium

position), $\overline{z^2}$ is determined by formula (5) (p. 28). In Chapter III*b* the same model was used to calculate the excess specific heat, caused by the anharmonic terms in the potential energy. This chapter also contains a discussion of the experimental results obtained for A*g* and P*d* (see fig. 4 p. 36). Attention is paid to the specific heat caused by the electrons. In Chapter III*c* a comparison is made with electrical resistance measurements. The resistance temperature curve and the A temperature curve of silver are shown to coincide provided a suitable choice is made for the units of the ordinate axes. MOTT has put forward a theory giving an explanation of the abnormal behaviour of palladium, platinum and tantalum. The results of the present thesis for the first time make it possible to separate experimentally the influence on the electrical resistance of the lattice vibrations and of the effect discussed by MOTT.